SH&G Submittal System – Add/Resubmit Form

Logged

MCI CONSTRUCTORS, INC. (Contractor's Name) 7649 DYNATECH CT, SPRINGFIELD VA 22153 (Address / State) 9-11-85 (Mail Date)

Type	Project No.	Contr. Suffix	Spec. Section	Page	Line	Actual Date In	Prom. Date Out	Manufacturer / Supplier
1	2 8	9 14	15 21	22 24	25 26	27 32	33 38	39 62
A	13155	C	15616	3/1	/			WORTHINGTON

Type: A Add, R Resubmit

C.A. Name: E. MEDLING

Discipline Routing (63 65 / 66 68 / 69 71 / 72 74 / 75 77) Responsibility (78 80)

Routing Order

Checkers Name

Distribution

1. EDP ☐ KP & KV

REVIEWED BY: CHERYL HERBERICH

Brian J. Flemenglish

Dup. Card3 1 2-26	Ref. No. 27 30	Type 31 33	Description 34 69
4	1	ltr	MCI CLARIFICATION LETTER
4	2	GG	WORTHINGTON CENTRIFUGAL, HORIZONTAL
4			SPLIT-CASE PUMPS MATERIAL INFO
4	3	GG	CENTRIFUGAL PUMPS-INSTRUCTION MANUAL
4			AND PARTS LIST- TYPES LR, LLR AND
4			FIRE PUMPS LRG
4	4	EG	PERFORMANCE CURVE-DEAERATOR #122
4			P-1, DWG NO ER-2494
4	5	pct	2 1/2 UNB-1.9 VOLUTE PUMP ELEVATION-
4			DEAERATOR #122, P-1, DWG NO RY-185822
4	6	GG	MATERIAL LIST FOR SECTIONAL ELEV
4			RW116899
4	7	pct	UNB VOLUTE PUMP SECTIONAL ELEVATION
4			DWG NO RW-116899
4	8	pct	TYPE-1B 2.250 D SHAFT SEAL DWG NO

RECEIVED SEP 16 1985

7-2-75

DHEG Submittal System – Add/Resubmit Form

MCI CONSTRUCTORS INC (Contractor's Name) 7649 DYNATECH CT, SPRINGFIELD VA 22153 (Address, State) 9-11-85 (Mail Date)

Type	Project No.	Contr. Suffix	Spec. Section	Page	Line	Actual Date In	Prom. Date Out	Manufacturer / Supplier
A	L3155	C	15616	J/A	/			WORTHINGTON

Type: A-Add, R-Resubmit

C.A. Name: E. MEDLING

Discipline Routing | Responsibility

Routing Order

Checkers Name

Distribution

1. EDP ☐ KP & KV

REVIEWED BY: CHERYL HERBERICH

Brian J. Flemingdyn

Dup. Card3 1 2-26	Ref. No. 27-30	Type 31-33	Description 34-69
4			F-SP-14000-HACK-GM
4	9	pct	OUTLINE, TOTALLY ENCLOSED FAN COOLED
4			BALL BRG DWG NO SL-810-050-424
4	10	pcc	PERFORMANCE CURVE-DEAERATOR #1,#2 P-2
4			CURVE NO A-19078
4	11	cc	PERFORMANCE CURVE-DEAERATOR #1,#2
4			P-3 CURVE NO A-19086
4	12	cc	PERFORMANCE CURVE-CONDENSATE P-1, P-2
4			CURVE NO A-19095
4	13	cc	PERFORMANCE CURVE-CONDENSATE P-3
4			CURVE NO A-19095
4	14	pct	21/2 LR-10 VOLUTE PUMP ELEVATION-
4			DEAERATOR #1,#2, P-3 DWG NO YX101729
4	15	pct	3LR-9 VOLUTE PUMP ELEVATION-
4			CONDENSATE P-3 DWG NO YX101729

7-2-75

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MCI CONSTRUCTORS, INC (Contractor's Name) | 7649 DYNATECH CT, SPRINGFIELD VA 22153 (Address, State) | 9-11-85 (Mail Date)

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Discipline Routing | Responsibility

Routing Order

Checkers Name

Distribution

1. EDP ☐ KP & KV

REVIEWED BY: CHERYL HERBERICH

Brian J. Flemingdym

Dup. Card3	Ref. No.	Type	Description
4	16	pct	OUTLINE-GAUGEBOARD DWG NO GD-199107
4	17	pct	OUTLINE-STEAM TURBINES SST 302T
4			DWG NO LE-178317

7-2-75

MCI CONSTRUCTORS, INC.

7649 Dynatech Court
Springfield. Virginia 22153

Address replies to:
P.O. Box 2786
Springfield. Virginia 22152

Telephone (703) 569-8010
TWX 710-831-0333 MCI ALE

CLIENT: General Services Administration

PROJECT: CIA Headquarters Expansion
Bid Package 3 - Powerhouse Modifications

SUBMITTAL DATE: September 11, 1985

SUBMITTAL NUMBER: 111

SPEC. SECTION: 15616 VENDOR: Worthington

EQUIPMENT DESCRIPTION: Boiler Feed and Deaerator Feed (Condensate Receiver) Pumps

STATUS: Approved for submittal as clarified

C.Q.C. REPRESENTATIVE: Brian J. Fleming

Brian J. Fleming

VARIATIONS AND CLARIFICATIONS

1. This submittal applies to the boiler feed and deaerator feed (condensate receiver) pumps as per Specification Section 15616, Paragraph 14.

2. Note that this is a partial submittal containing information on the following:

Deaerator No. 1 and 2	Pumps P-1 and P-2
Condensate Receiver	Pump P-3

Only the performance curves for deaerator Numbers 1 and 2, Pump P-2 and condensate receiver Pumps P-1 and P-2 are being submitted at this time. Complete information on these pumps will be submitted upon receipt from the vendor.

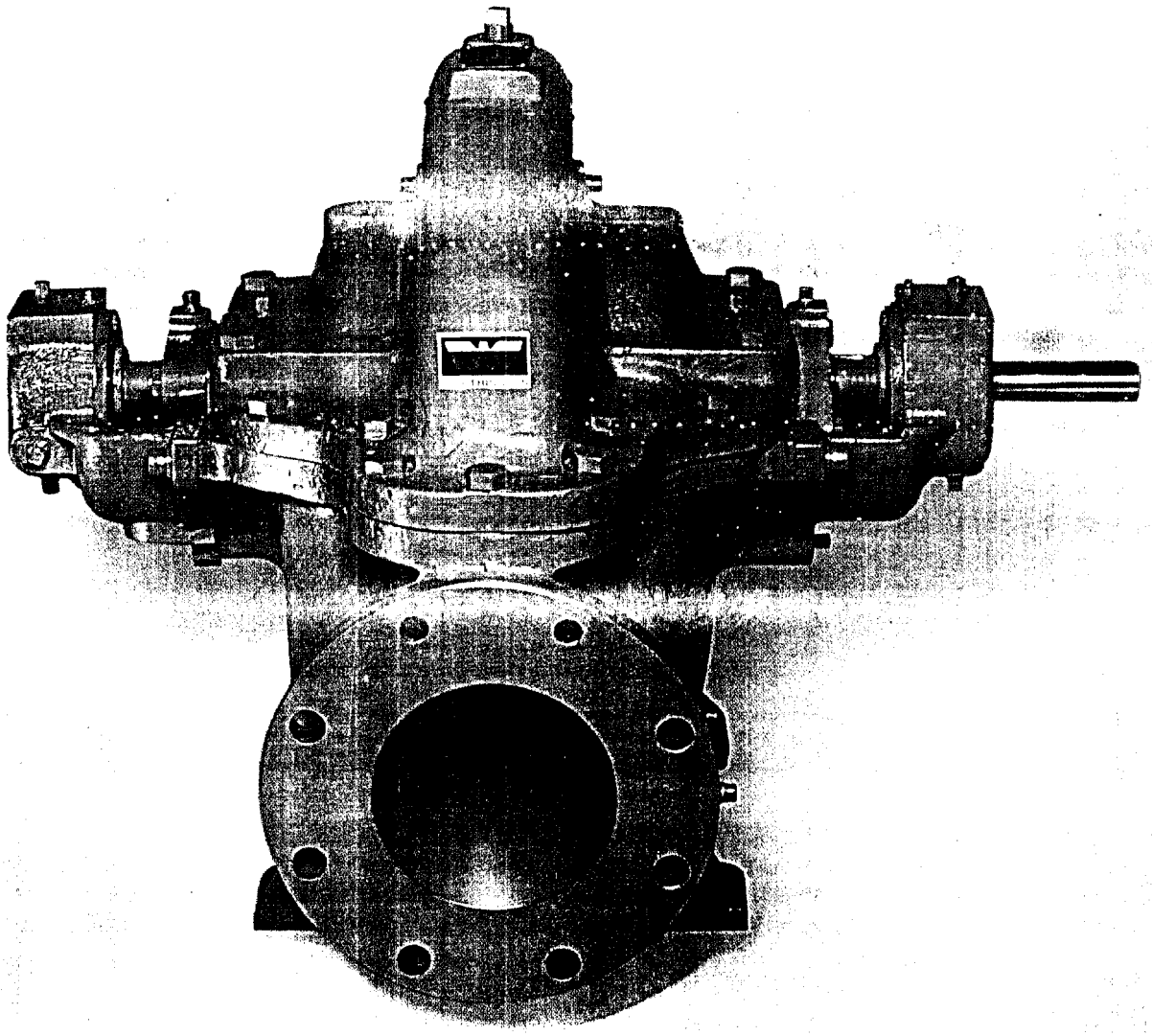
3. Also note that MCI is submitting motors for deaerator Numbers 1 and 2 with the following RPM ratings:

Deaerator No's 1 and 2	P-1	3550 RPM
Deaerator No's 1 and 2	P-2	3530 RPM
Deaerator No's 1 and 2	P-3	3550 RPM

The manufacturer recommends, for efficiency purposes, that a higher RPM rated motor be used for these pumps. MCI requests approval of this deviation.

Worthington

centrifugal, horizontal split-case pumps.



Sizes 1½ to 16 inches • capacities to 70,000 gpm • heads to 800 feet

McGRAW-EDISON

Worthington

A broad line of field proven, split-case pumps for a wide variety of applications.

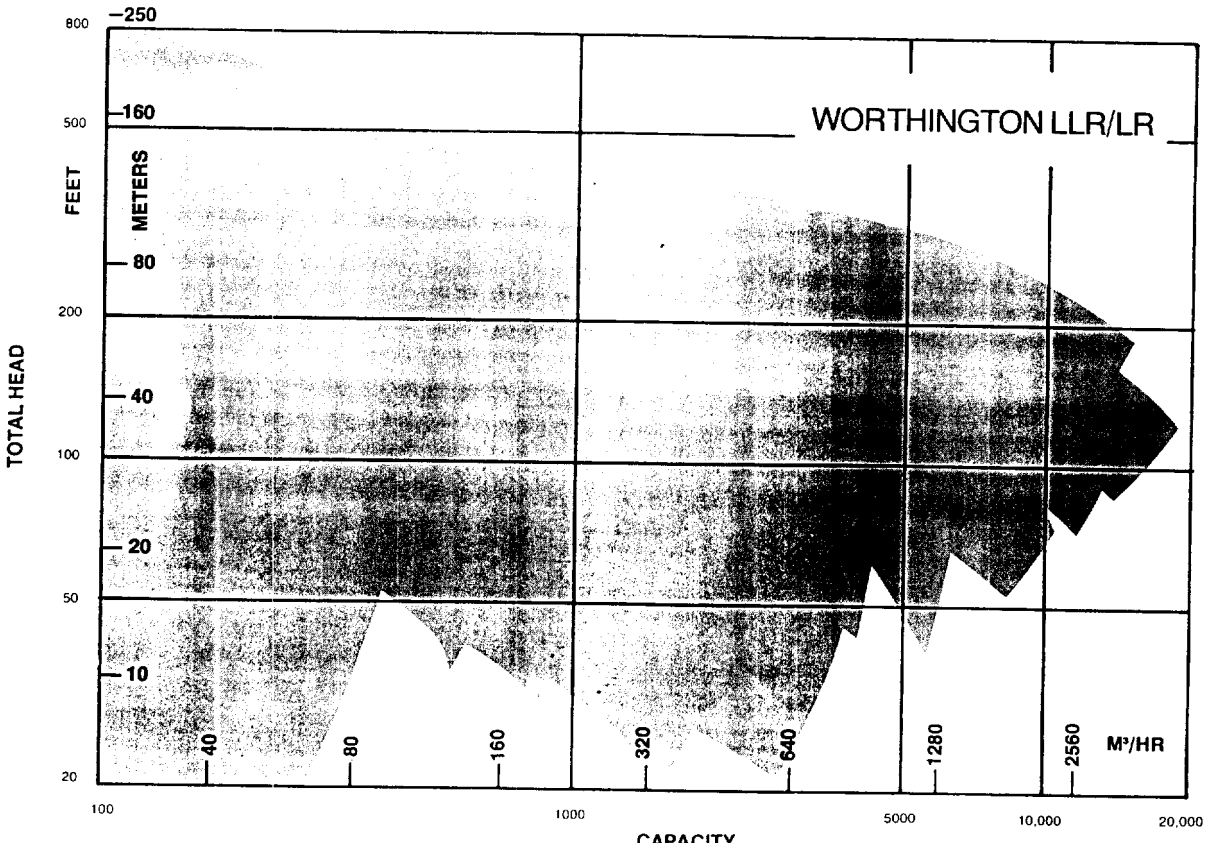
Worthington's LR line offers you 26 horizontal and 14 vertical sizes with capacities to 19,000 gpm, heads to 800 feet, in sizes 1½" through 16". Larger custom-engineered sizes are available to 50,000 gpm, heads to 600 feet, and sizes to 36".

Worthington LR split-case pumps offer many benefits. They provide a wider range of hydraulic coverage than other typical horizontal split-case pumps and end-suction designs. Split-case pumps minimize the effects of radial load by allowing the radial thrust to be shared equally by the bearings at each end of the shaft. This results in much longer bearing life than end-suction designs where one bearing must support 2 times the radial load of the impeller. Split-case designs allow for balanced axial loading, high efficiency and low NPSH with double-suction closed impellers. Rugged, heavy-duty construction coupled with superior design features make this line of pumps very reliable. Low initial investment and high efficiency make overall cost very attractive.

Also, Worthington LR Type horizontal split-case pumps are designed to ensure ease of maintenance and parts interchangeability. That means additional savings from reduced downtime and minimum need for parts inventory.

Typical industries served.

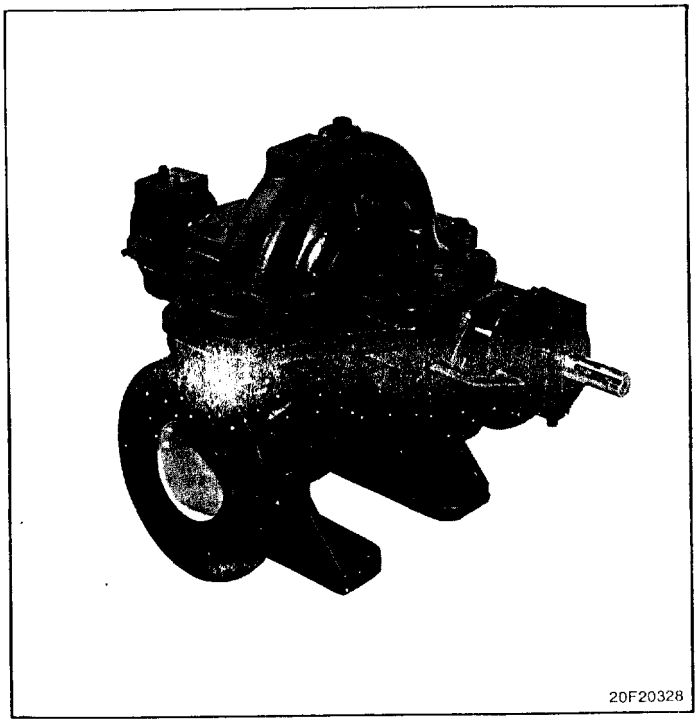
- ☐ process
- ☐ building trades
- ☐ fire protection
- ☐ food
- ☐ mining
- ☐ steel
- ☐ sugar
- ☐ utilities
- ☐ public works
- ☐ petroleum
- ☐ pharmaceutical
- ☐ pipeline
- ☐ agriculture
- ☐ pulp and paper
- ☐ rubber



The heart of the Worthington split-case line is the LR, single-stage, double-suction impeller design. Double-suction impellers offer two advantages: reduced NPSH requirements up to 30%, and balanced axial thrust for longer bearing life. They are available in sizes 3" to 12" to meet a broad range of application requirements.

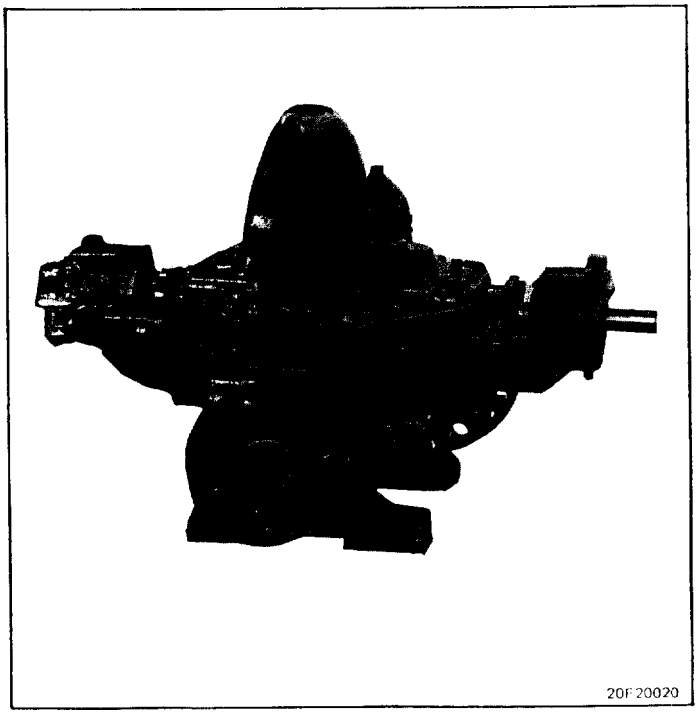
The model LLR, single-suction, two-stage designs are available in 1½-2" sizes. They feature two single-suction impellers placed back-to-back to minimize axial thrust. Radial thrust is balanced through the use of opposed volutes. Impellers are firmly secured to the shaft by use of a key and nut.

The following pages illustrate the superiority of the Worthington split-case line over competitive conventional designs.



TYPE LR

Sizes: 3" to 16"
Capacities: To 19,000 gpm
Heads: To 500'
Temperatures: To 300°F



TYPE LLR

Sizes: 1½" to 2"
Capacities: To 350 gpm
Heads: To 800'
Temperatures: To 300°F

Superior rotor alignment, shaft design and pump mounting ensure maximum reliability.

This section will clarify the superior strength and reliability of Worthington LR line in comparison with designs of other conventional split-case pumps.

Bearing housing attachment to casing assures accurate rotor alignment.

Misalignment of the rotor and casing can cause premature bearing failure, internal rubbing, packing or mechanical seal failure — and result in costly downtime and loss of production.

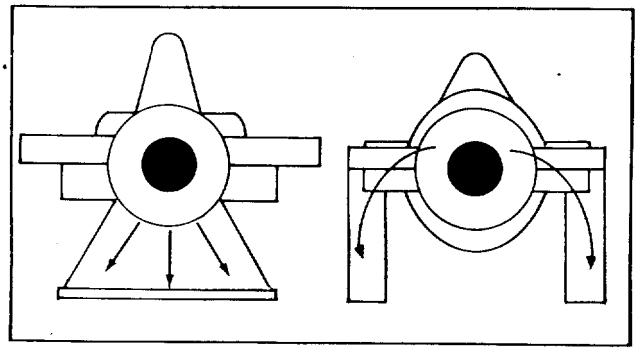
Worthington assures accurate alignment by use of precision-machined straight-dowel bushings. Tap bolts firmly secure the separate bearing brackets which also form the bearing housing to the casing (see illustration A). This is far superior to rabbet-fit or tongue-in-groove mountings which sometimes include a "strap" bolted to the pump casing. Other designs are simply bolted to the frame without other type fitting.

Worthington uses the most modern boring methods available. All bearing bores and dowel bores are located to within .001 inches! As an assembly, Worthington concentricity of bracket bores and the casing bore are held very close. This ability to machine with such preciseness, coupled with dowel-bushing feature to align the bearing bracket, provides the greatest assurance of bearing-bracket and pump-casing alignment.

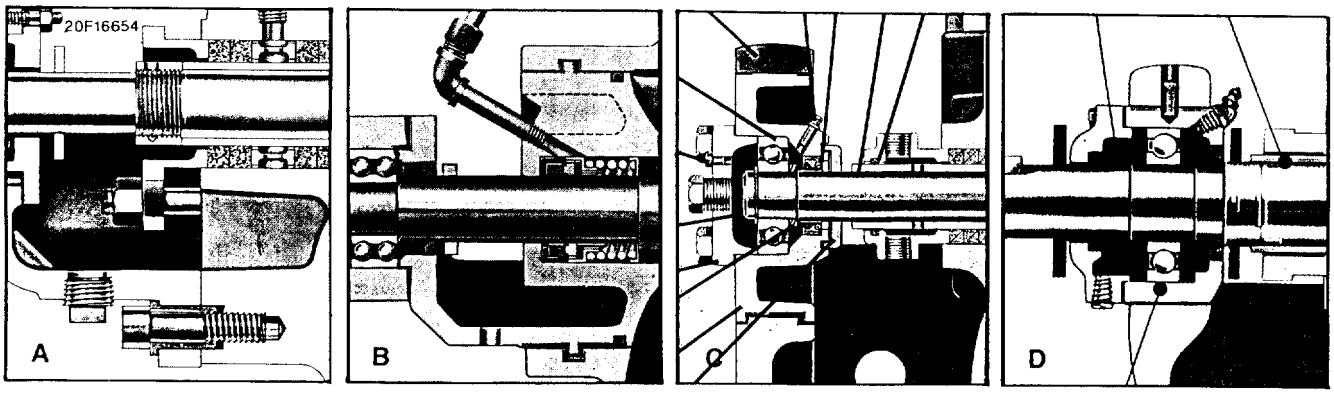
A look at other bearing-bracket-to- housing designs shows the following: B is cast integral with the stuffing box and positioned with only a rabbet fit. The stuffing box itself is tongue-in-groove to upper casing and sealed by "O" rings. This design requires the upper and lower casing halves to clamp together perfectly in order for the "O" ring seal to be effective. The bearing positioning is dependent upon three critical fits. C shows the tongue-in-groove design off the bottom of the casing secured with a bolt-on bearing cap. In D, the bearing housing is clamped to the lower casing extension with only a bolt-on bearing cap. The use of a pin between bearing housing and bearing cap prevents bearing housing from rotating.

Casing feet design assures long bearing life.

With Worthington's design (left below), the casing feet are mounted very close to the flanges. This allows for the immediate transmission of any pipe load through the feet and away from the upper casing — which minimizes the possibility of shifting and coupling misalignment causing premature bearing failure. Some designs (right below) use a separate mount under the bearing brackets. Pipe loads are thus transmitted through the pump flanges, suction and/or discharge, and through the pump casing shaft since the foot is only bolted under the bearing bracket.



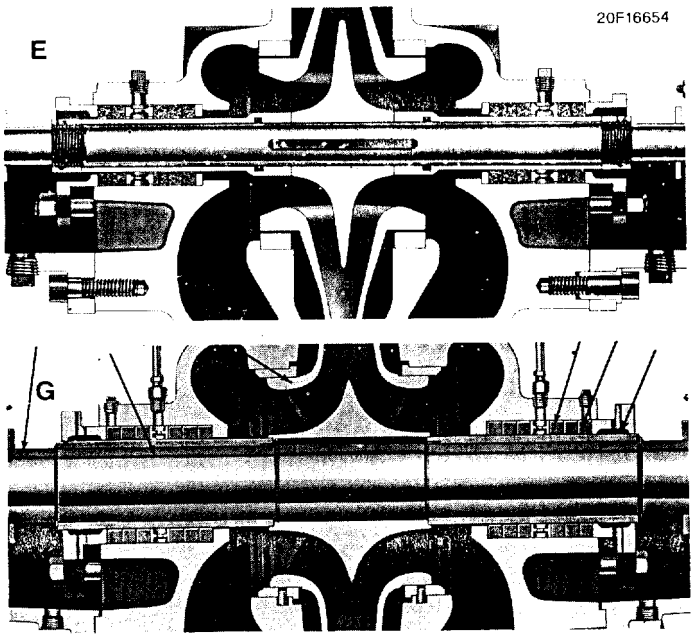
Arrows depict the paths of pipe-strain transmission to pump feet. Location of pump feet on Worthington model (left) is more conducive to direct transmission in order to minimize problems with coupling alignment.

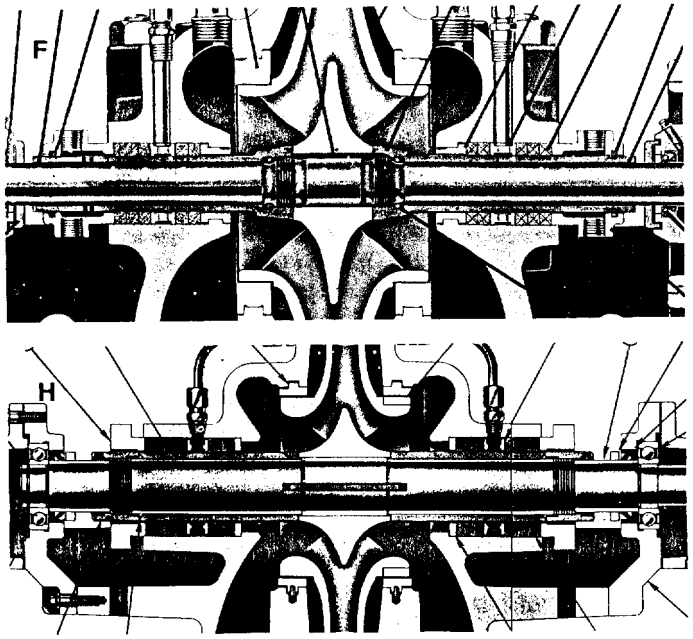


In the LR pump shown in illustration A, bearing brackets are accurately aligned by straight dowel bushings. Tap bolts firmly secure brackets to the casing. Bearing and pre-machined dowel bores are located to .001 inches true position tolerance.

Shaft design and shaft-sleeve attachment minimize stress fatigue.

The highest loads on a horizontal split-case pump shaft caused by radial hydraulic thrust occur at the impeller. Threads, undercuts, etc., in this shaft area can cause high-stress concentration. This results in fatigue failure of the shaft after a large number of stress reversals brought on by part load operation and radial deflection.





Worthington LR's, shown in illustration E, maintain the same shaft diameter from one shaft sleeve locknut to the other — minimizing the potential of fatigue failure due to stress reversals. Worthington shaft sleeves are keyed to the shaft, and positioned and locked by the shaft-sleeve nuts at the outer end of the sleeve. Impeller alignment can be properly adjusted by turning the shaft-sleeve nuts in or out — a relatively easy maintenance feature. The shaft-sleeve threads are outside the "O" ring and external to the stuffing box, minimizing deterioration due to corrosion. Since both shaft sleeves as well as the impeller share the same key, a positive drive is assured on both sleeves. This design, in conjunction with removable bearing brackets, allows for most replacement seals to be installed without disturbing the upper casing half.

An alternative design shown in illustration F keys only one shaft sleeve. The shaft sleeves themselves are threaded to the shaft, in lieu of a separate sleeve locknut. The threaded area is in the wet-end assembly at the hub of the impeller. It is not external to the stuffing box which increases the danger of leakage corroding the threads — a messy maintenance problem since the threads are also located inside the "O" ring. This design is susceptible to shaft-stress fatigue failure. To accommodate opposite pump rotation, the complete rotating assembly must be disassembled and rebuilt, reversing the sleeves.

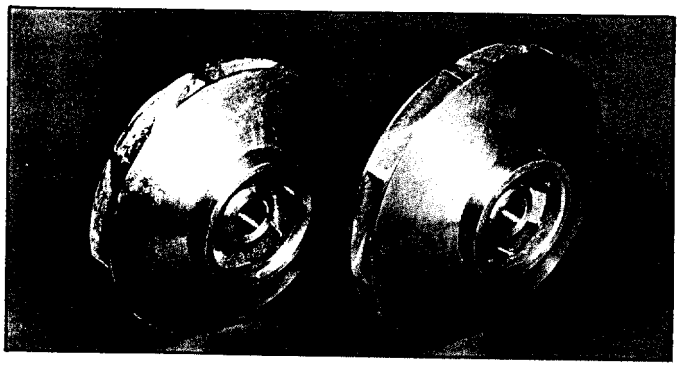
The design in illustration G, while using a sleeve driven through a key, has no threads for axial adjustment of the impeller! The shaft sleeves are locked on by snap rings, rigidly positioned to locate the impeller and requiring shims to adjust it. Gaskets in lieu of "O" rings are used to protect against leakage. There is also the potential for any hydraulic thrust transmitted through the sleeve to cause the snap ring to pop off the shaft, resulting in serious internal pump damage. The shaft is also stepped at the impeller hub and thus is susceptible to shaft-stress fatigue failure.

The design in illustration H has both sleeves keyed to the shaft and secured by a locknut screwed to the shaft. The shaft sleeve "O" ring is at the outboard end of the sleeve and leakage may occur at the impeller end. Corrosion under the sleeve is also a possibility. The shaft, because it is stepped at the impeller hub, is more likely to experience stress fatigue failure.

A unique combination of design features leads to higher efficiencies and lower maintenance requirements.

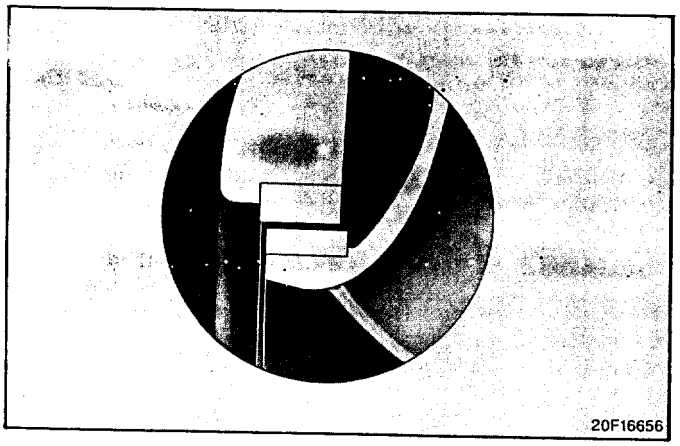
Closed impellers mean high efficiency.

Highly efficient closed impellers mean energy savings for you. All closed impellers are hydraulically balanced to further reduce bearing loads. Experience and research has shown that closed impellers retain their efficiency better. Closed impellers also offer inherently greater axial hydraulic balance minimizing thrust loads,resulting in longer bearing life (see page 15).



Wear rings designed for easy replacement.

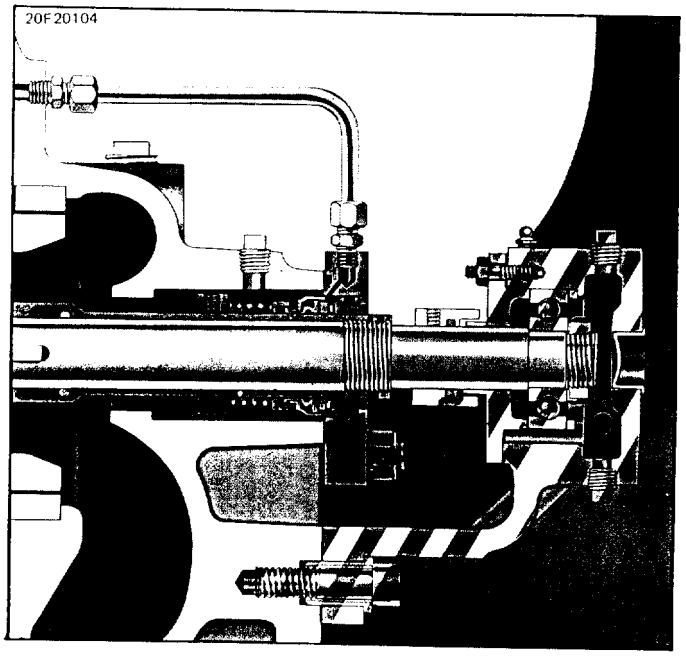
Worthington case wearing rings protect the pump casing from needless wear. They are renewable and held in place and protected against rotation by monel pins. Once again, Worthington has designed a feature for quick and easy replacement to reduce maintenance downtime and costs. The wear rings are less complex than other designs and embody a simple, heavy-cross section rectangular design for positive fit. Competitive designs use a wear ring step bushing with pin type that is L-shaped or a "tongue-in-groove" design. Both are more difficult to replace.

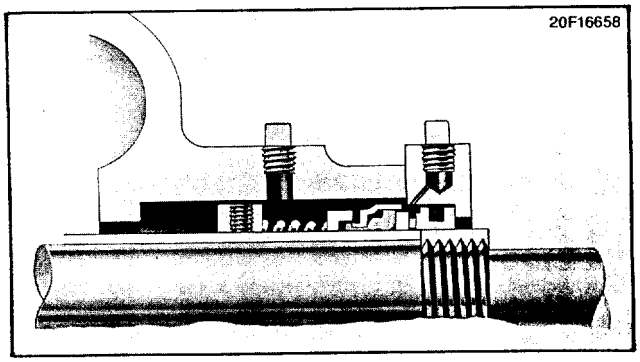


Ease of access for easy maintenance.

Merely remove the bearing brackets (crosshatched area at right) to inspect and maintain key components such as bearings, seals, packing, and shaft sleeves. There's absolutely no need to remove the upper pump casing for access to these components — which reduces maintenance time and effort appreciably.

This removable-bracket design also achieves a shorter distance between bearings which provides a more rigid shaft — resulting in less shaft deflection.



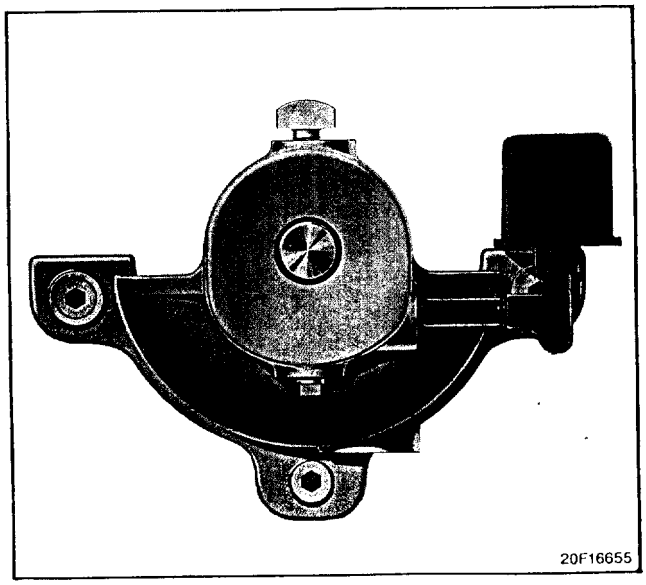


Stuffing box designed for long packing/seal life.

Because the seals or packing in the LR are adjacent to the suction side of the impeller, they are sealing against the lowest pressure available. Worthington employs a conventional type stuffing box — that is, easily convertible for use with packing or mechanical seal.

Oil and grease lubricated bearings.

Compatibility with your application is assured because you can choose either oil or grease lubricated bearings. And you can easily change from one to the other using the same bearing housing to meet different plant specifications. The LR has fittings for grease lubrication, and a constant-level oiler for oil lubrication. Some designs require different shaft assemblies for alternate lubrication.



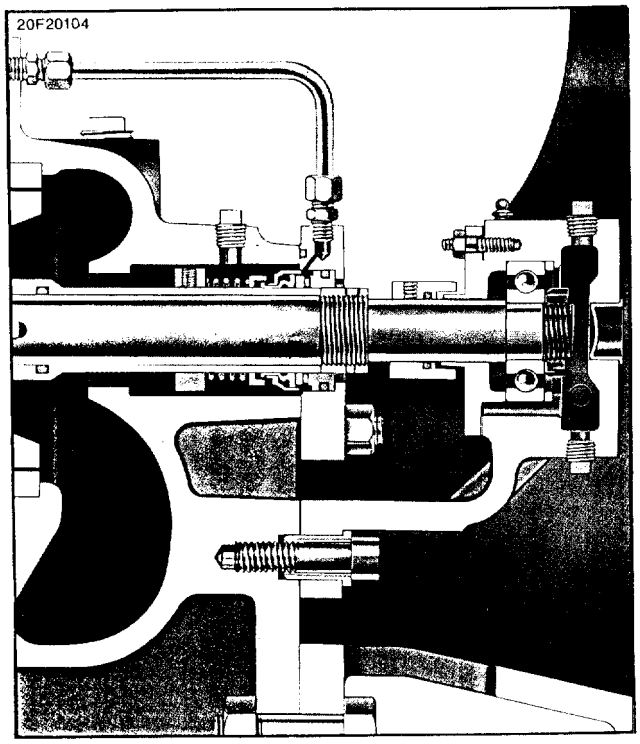
Bearing securely attached to shaft.

The thrust bearing is attached to the shaft by a locknut and washer — a method that assures a more positive fit, and is more reliable than snap rings which can bend and pop out.

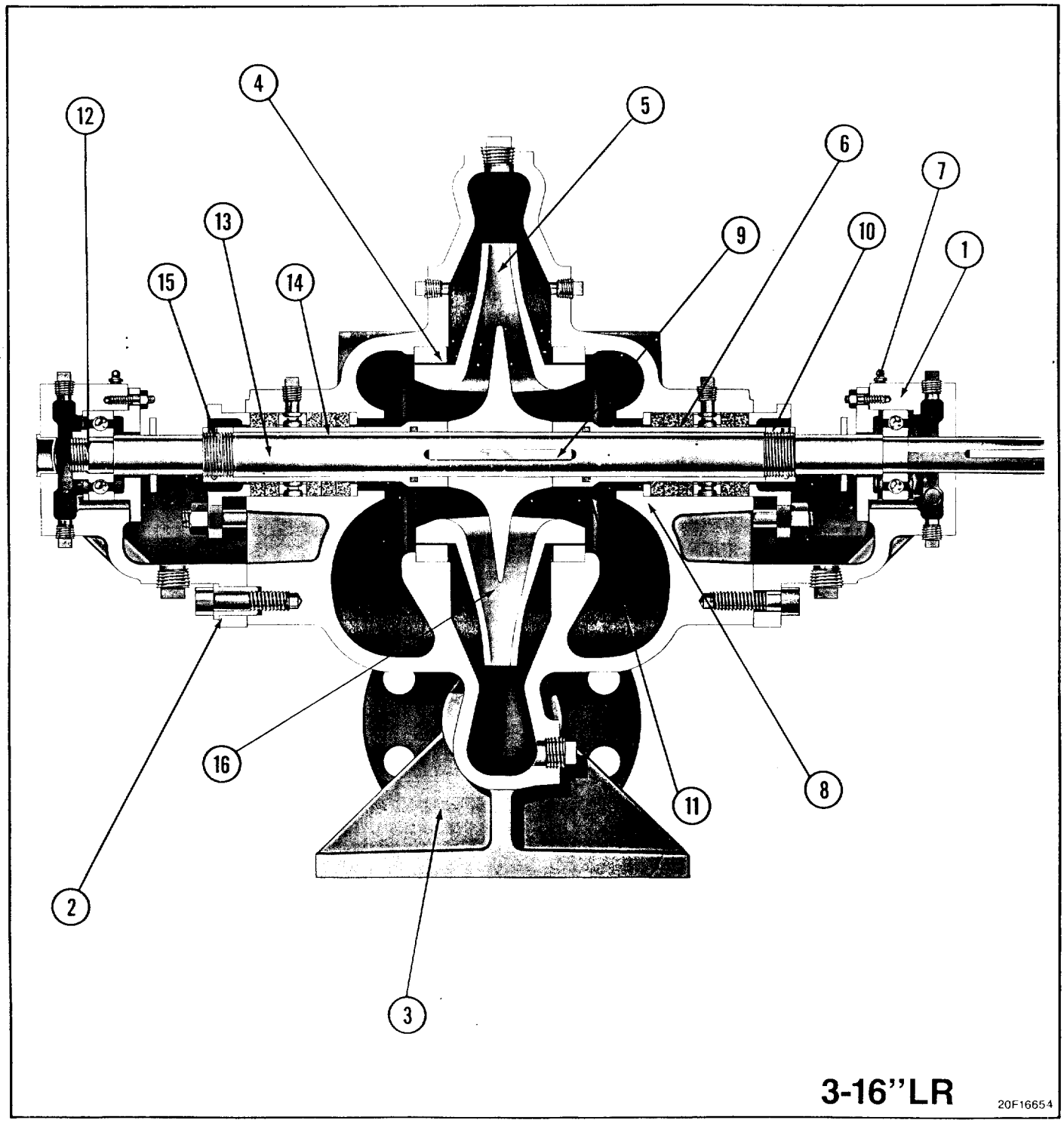
More ease of maintenance features.

Maintenance time costs money in labor, parts and reduced production. Check these additional features designed to reduce periodic and unscheduled downtime:

- ☐ Removable, replaceable stuffing box bushing to ensure proper packing position.
- ☐ Wide range of construction materials to meet conditions of service and thus contribute to lower operating and maintenance costs.
- ☐ Shaft-sleeve nuts set-screwed to shaft prevent nuts from loosening. Also location exterior to stuffing box allows visibility to assure maintenance of impeller positioning.
- ☐ Impeller supported between bearings, rather than overhung like an end-suction centrifugal, reduces bearing load and increases life.

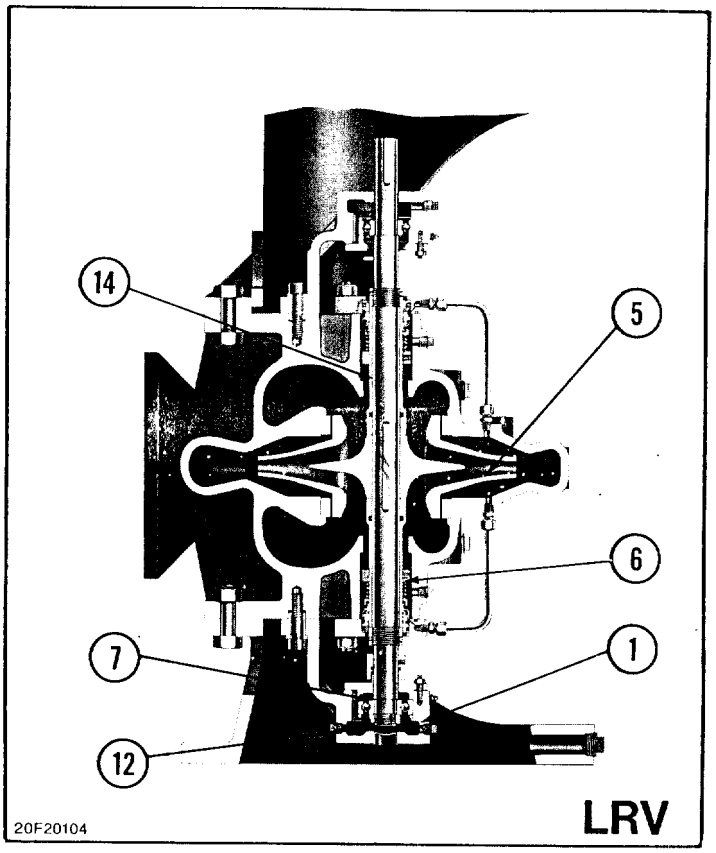


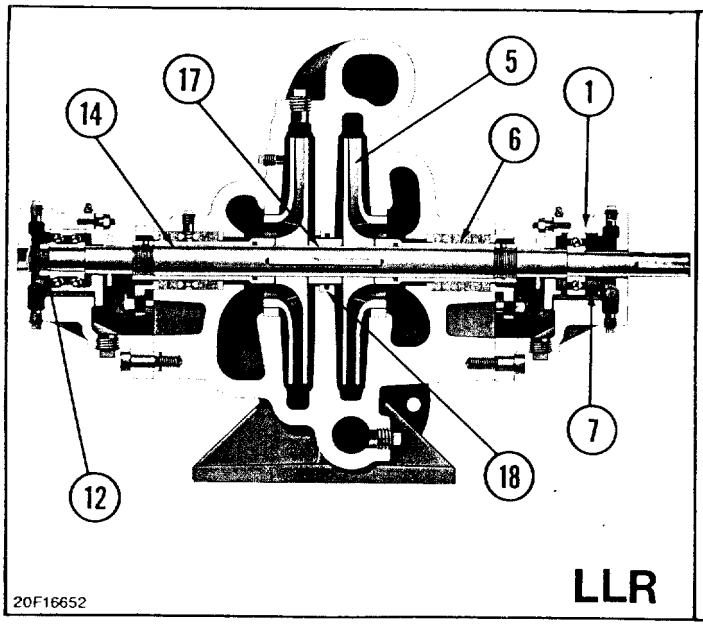
Designs and sizes available to meet your specific application requirements.

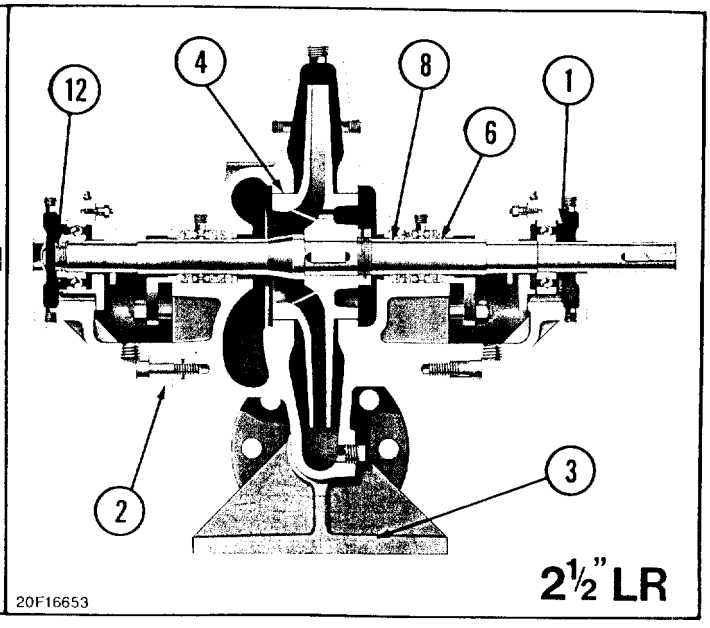


Key Features

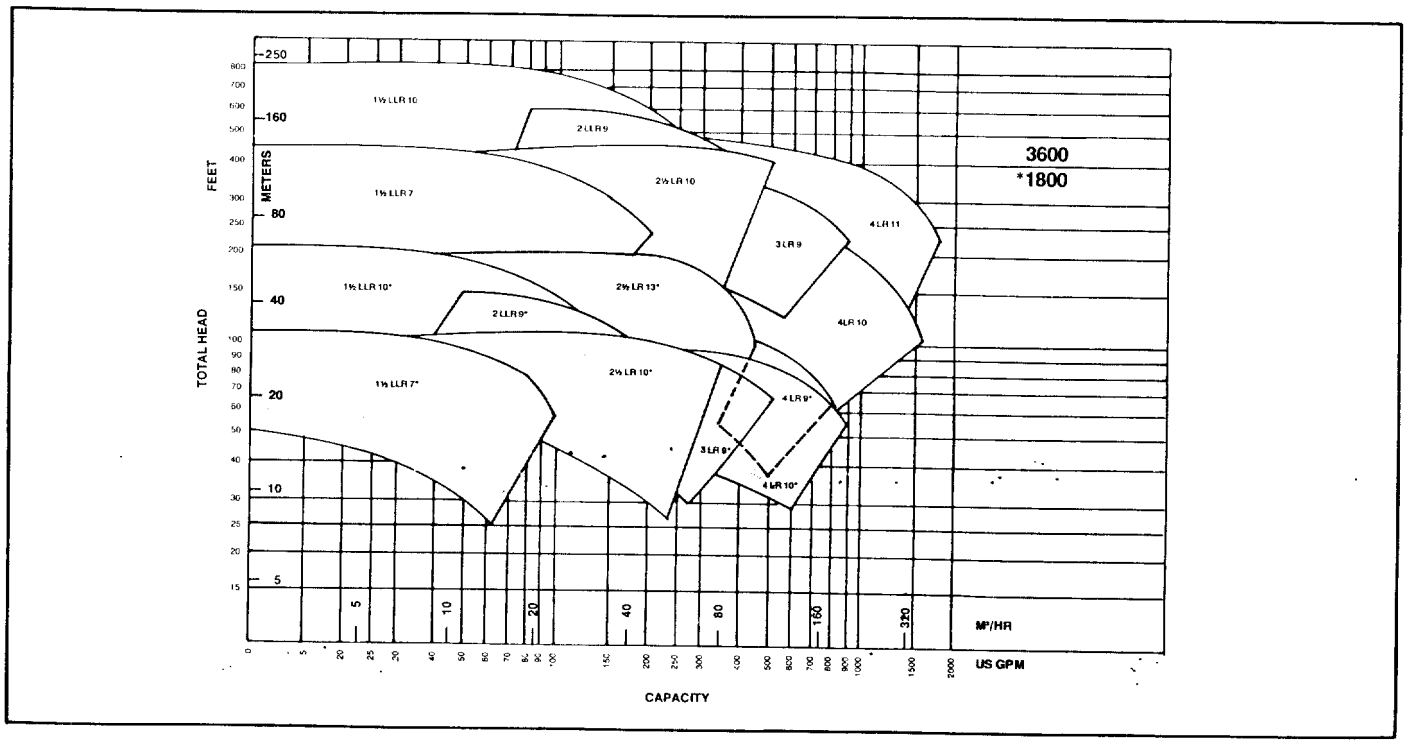
1. Separate Bearing Brackets
2. Straight Dowel Bushings
3. Mounting Feet Adjacent to Flanges
4. Heavy Duty Case Ring
5. Closed Impeller
6. Convertible Box
7. Oil or Grease Lubrication
8. Removable Stuffing Box Bushing
9. Shaft Sleeves Keyed to Shaft
10. Sleeve Locknuts External to Stuffing Box
11. "O" Ring Shaft Sleeve Seal
12. Bearing Locknut & Washer
13. Heat Treated Steel Shaft
14. Renewable Shaft Sleeves
15. Shaft Sleeve Nuts Set – Screwed to Shaft
16. High Efficiency, Low NPSH Impellers
17. Keyed Spacer Sleeve
18. Replacable Interstage Bushing

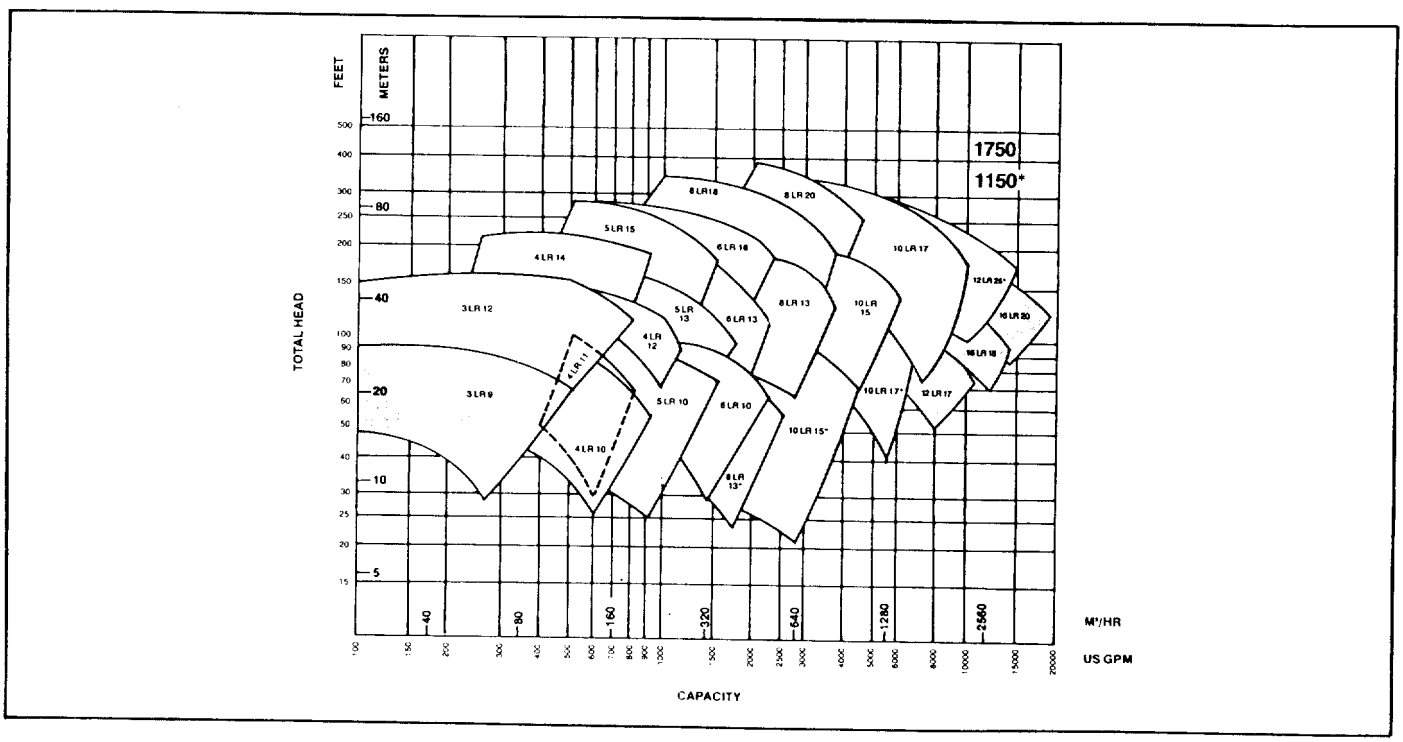




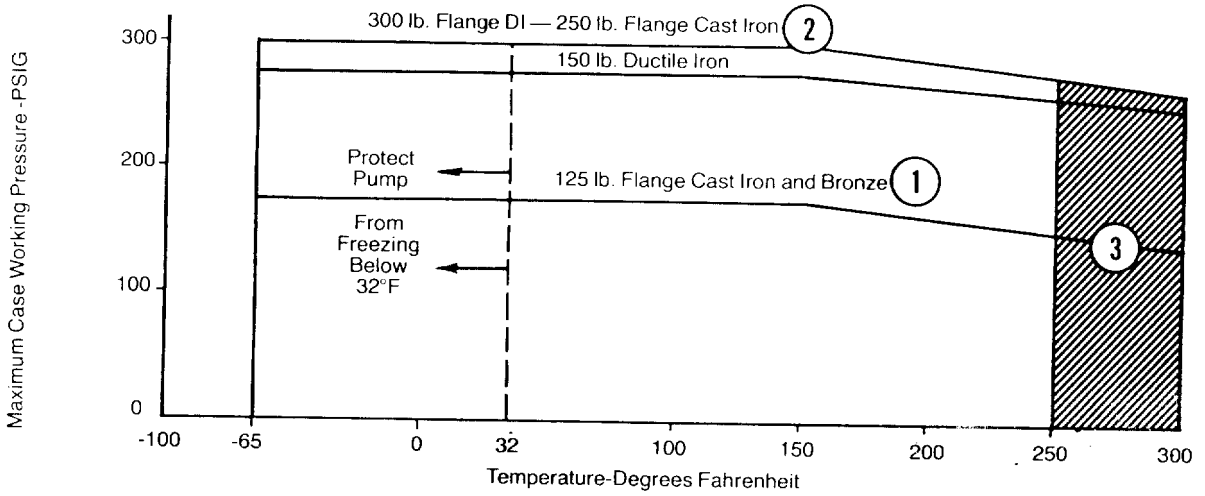


Extensive coverage for better selection at any design point.





Maximum Working Pressure Limits

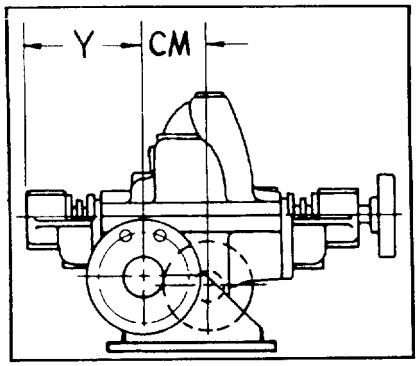


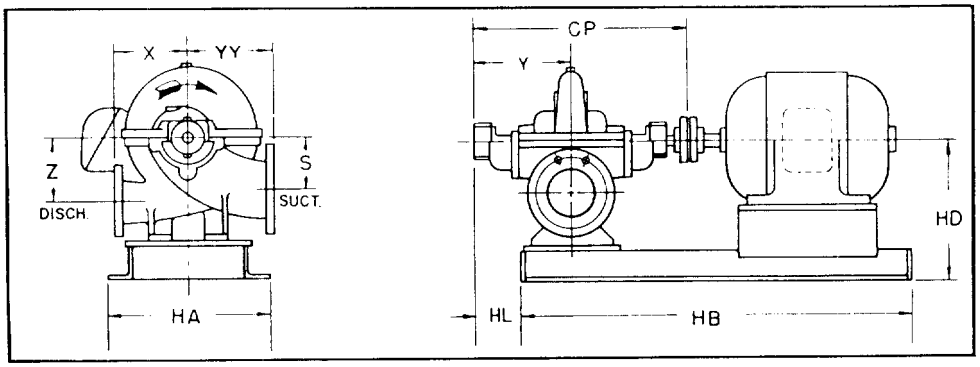
1. Maximum casing working pressure for M3445 bronze
2. ASTM A-48 class 50 cast iron, SAE class 5 high tensile steel bolting and J. Crane type, BP-1D1 seal.
3. All iron and s.s. fitted construction with single or double rings quench gland w/packing or vent & drain gland with mechanical seal and oil lubrication

Pump Size & Type				Maximum Pressure Ratings (Psi)				Casing Thick-ness (5)	Wearing Ring Clearance (6)	ID Casing Ring	Impeller WR²
				Cast Iron - 125 Lb. Std. Flat Face Flanges (4)		Cast Iron - 250 Lb. Std. Flat Face Flanges (4)					
Horizontal	Vertical (1)	Disch. In.	Suct. In.	Suction	Hydro. Test	Suction	Hydro. Test	In.	In.	In.	lbs-ft² (7)
1½LLR7	—	1½	2	150	265	150	450	.38	.010-.014	3¾	0.10
1½LLR10 (2)	—	1½	3	—	—	150	450	.56	.010-.014	3¾	0.22
2LLR9(2)	—	2	3	—	—	150	450	.56	.012-.016	4 1/16	0.22
2½LR10 (2)	—	2½	3	—	—	150	450	.50	.010-.014	3¾	0.60
2½LR13	—	2½	4	150	265	150	450	.38	.012-.016	4⅞	1.80
3LR9	3LRV9	3	4	150	265	150	450	.38	.012-.016	4 1/16	0.61
3LR12	3LRV12	3	5	150	265	150	450	.38	.012-.016	4⅞	0.23
4LR10	4LRV10	4	5	150	265	150	450	.38	.012-.016	4⅞	0.87
4LR11 (3)	4LRV11 (3)	4	6	150	265	150	450	.44	.012-.016	4⅞	1.20
4LR12	4LRV12	4	6	150	265	150	450	.38	.012-.016	4⅞	2.00
4LR14	4LRV14	4	6	150	265	150	450	.50	.012-.016	4⅞	4.00
5LR10	5LRV10	5	6	150	265	150	450	.38	.012-.016	5½	1.40
5LR13	5LRV13	5	6	150	265	150	450	.50	.012-.016	5½	4.40
5LR15	5LRV15	5	6	150	265	150	450	.56	.012-.016	5½	6.40
6LR10	6LRV10	6	8	150	265	150	450	.44	.012-.016	6 3/16	1.80
6LR13	6LRV13	6	8	150	265	150	450	.56	.012-.016	6 3/16	3.90
6LR16	6LRV16	6	8	150	265	150	450	.62	.012-.016	6 3/16	5.60
6LR18 (3)	—	6	10	150	265	150	450	.62	.012-.016	7½	10.0
8LR13 (3)	8LRV13 (3)	8	10	150	265	150	450	.50	.012-.016	7½	11.0
8LR20 (3)	8LRV20 (3)	8	12	150	412	150	450	.62	.018-.024	9	16.8
10LR15 (3)	10LRV15 (3)	10	12	150	265	150	450	.62	.018-.024	8⅞	17.50
10LR18 (3)		10	14	150	412	150	450	.67	.018-.024	11	19.0
12LR17 (3)		12	18	125	175	175	250	.75	.020-.024	11½	21
12LR25 (3)		12	18	150	412	150	412	.75	.020-.024	14¼	49
16LR18 (3)		16	20	125	175	175	250	.88	.020-.024	12½	35
16LR20 (3)		16	24	125	175	175	250	1.00	.020-.026	14	52

1 250 lb flange not available on LRV pumps.
2 Pumps supplied with 250 lb FF Flange
3 Twin volute casings
4 8LR20 & 10LR18 & 12LR25 — ductile iron case ASTM A395 grade 60-40-18. Flange ratings 150 lb. & 300 lb. F.F.
5 Corrosion allowance ⅛ inc.
6 For standard fitted, all iron and bronze construction. For double stainless rings, clearances are 50% greater.
7 For dry rotor. Add 30% for wet rotor

Dimensions





PUMP DIMENSIONS

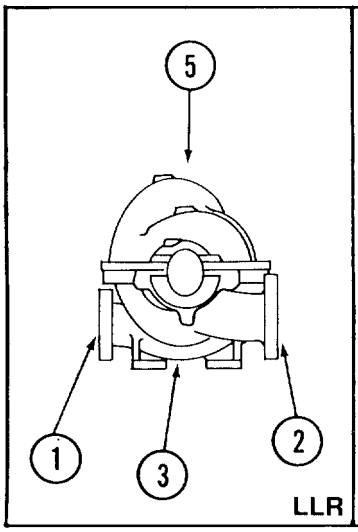
pump size		suct.	disch.	S	X	Y	Z	CP	CM	YY	HD	HL	WT	base
1½	LLR-7	2	1½	3½	6¾	9¾	4¾	26¾	3¼	6¾	12½	4	200	1
1½	LLR-10	3	1½	4¼	8½	10½	5¼	26¾	4	8½	13¼	4	360	1
2	LLR-9	3	2	4¼	8	10⅞	5	26¾	4½	8⅜	13¼	4	290	1
2½	LR-10	3	2½	5	8	10¼	6½	23	1½	8¾	15	6	220	1
2½	LR-13	4	2½	5¾	9½	11⅛	7½	24⅝	1½	10	16	7	250	1
3	LR-9	4	3	5¼	7½	12	5¾	26¾	—	9	15	6¼	220	1
3	LR-12	5	3	5¾	8⅜	12	7¼	26¾	—	10½	16	6¼	280	1
4	LR-10	5	4	5¾	9	12	6¼	26¾	—	11	16	6¼	280	1
4	LR-11	6	4	6⅜	10	13	6½	30	—	12½	17½	6	320	2
4	LR-12	6	4	6⅜	9	12¼	7¾	27	—	11	17½	6	400	1
4	LR-14	6	4	6⅜	12	13	7⅝	30	—	12½	17½	6	385	2
5	LR-10	6	5	6½	9½	12¼	7	27	—	13	17½	6	370	2
5	LR-13	6	5	6½	10½	13	7¼	30	—	13	17½	6	425	2
5	LR-15	6	5	6½	13	14¾	7¼	34	—	13½	17½	7¾	600	1
6	LR-10	8	6	7¾	10	13	7½	28⅛	—	14	20	6	425	2
6	LR-13	8	6	7½	11	14¾	9	34	—	14	20	7¾	610	1
6	LR-16	8	6	7⅝	14	14¾	8½	34	—	15	20	7¾	680	1
6	LR-18	10	6	9	12½	14¾	10½	39	—	17	24¾	12	1000	3
8	LR-13	10	8	8⅞	11½	17¼	10	34	—	17	24¼	7¾	780	1
8	LR-20	12	8	10½	14½	17¼	15¼	39	—	18	27¾	12	1059	3
10	LR-15	12	10	10½	14	17¼	10½	39	—	18	27¾	12	1185	3
10	LR-18	14	10	12	16	19⅛	13¼	45⅛	—	19½	30	8¾	1500	4
12	LR-17	18	12	16	20	23	16	50¼	—	26	—	—	—	—
12	LR-25	18	12	14½	21	23 9/16	18	54.10	—	24¾	—	—	—	—
16	LR-18	20	16	18	22	24⅝	18	56	—	28	—	—	—	—
16	LR-20	24	16	20	24	27¾	20	62.45	—	32	—	—	—	—

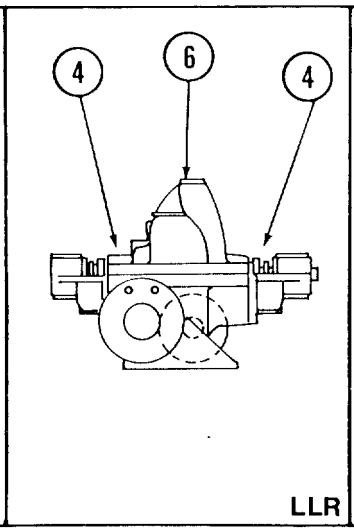
BASE DIMENSIONS

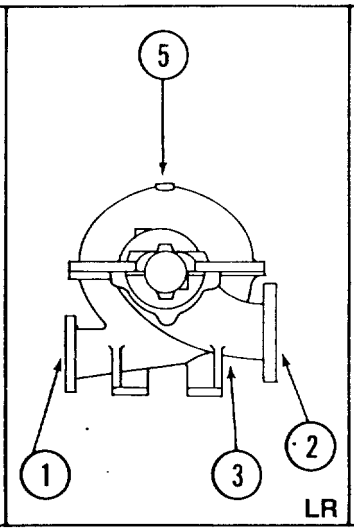
nema frame motor	base 1			base 2			base 3			base 4			base 5		
	HA	HB	WT base	HA	HB	WT base	HA	HB	WT base	HA	HB	WT base	HA	HB	WT base
182T	24	41¾	210	24	41¾	210	—	—	—	—	—	—	—	—	—
184T	24	41¾	210	24	41¾	210	—	—	—	—	—	—	—	—	—
213T	24	41¾	210	24	41¾	210	—	—	—	—	—	—	—	—	—
215T	24	41¾	210	24	41¾	210	—	—	—	—	—	—	—	—	—
254T	24	41¾	210	24	54½	230	—	—	—	—	—	—	—	—	—
256T	24	41¾	210	24	54½	230	—	—	—	—	—	—	—	—	—
284T	24	54½	230	24	54½	230	—	—	—	—	—	—	—	—	—
286T	24	54½	230	24	54½	230	28	60	410	—	—	—	—	—	—
324T	24	54½	230	24	54½	230	28	60	410	—	—	—	—	—	—
326T	24	54½	230	24	54½	230	28	60	410	—	—	—	—	—	—
364T	24	54½	230	24	54½	230	28	60	410	—	—	—	—	—	—
365T	24	54½	230	24	54½	230	28	60	410	—	—	—	—	—	—
404T	24	64½	250	24	54½	230	32	66	510	32	72	600	—	—	—
405T	24	64¼	250	24	54½	230	32	66	510	32	72	600	—	—	—
444T	24	64¼	250	24	64¼	250	32	66	510	32	72	600	—	—	—
445T	24	64¼	250	24	64¼	250	32	66	510	32	84	640			
447T	—	—	—	—	—	—	—	—	—	32	84	640	—	—	—
449T	—	—	—	—	—	—	—	—	—	32	84	640	42	115	820

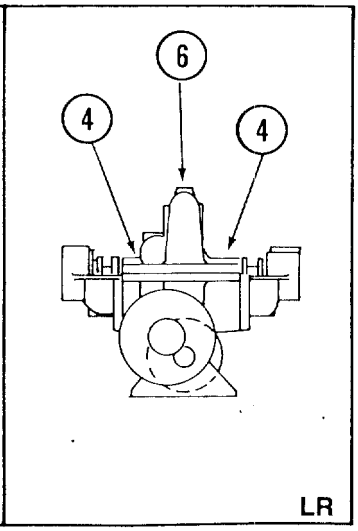
Baseplate dimensions will vary slightly with motor Frame size. All dimensions are in inches are approximate and not to be used for construction purposes.

NPT connections.









PUMP SIZE	CASING CONNECTIONS					
	1	2	3	4	5	6
1½LLR7	¼	¼	½	¼	½	¼
1½LLR10	¼	¼	½	¼	½	¼
2LLR9	¼	¼	½	¼	½	¼
2½LR10	¼	¼	½	¼	½	¼
2½LR13	¼	¼	½	¼	½	¼
3LR9	¼	¼	½	¼	½	¼
3LR12	¼	¼	½	¼	½	¼
4LR10	¼	¼	½	¼	½	¼
4LR11	¼	¼	½	¼	½	¼
4LR12	¼	¼	½	¼	½	¼
4LR14	¼	¼	½	¼	½	¼
5LR10	¼	¼	½	¼	½	¼
5LR13	¼	¼	½	¼	½	¼
5LR15	¼	¼	½	¼	½	¼
6LR10	¼	¼	½	¼	½	¼
6LR13	¼	¼	½	¼	½	¼
6LR16	¼	¼	½	¼	½	¼
6LR18	¼	¼	¾	¼	¾	¼
8LR13	¼	¼	¾	¼	¾	¼
8LR20	¼	¼	1	¼	¾	¼
10LR15	¼	¼	¾	¼	¾	¼
10LR18	¼	¼	1	¼	¾	¼
12LR17	¼	¼	¾	¼	¾	¼
12LR25	¼	¼	¾	¼	¾	¼
16LR18	¼	¼	¾	¼	¾	¼
16LR20	¼	¼	¾	¼	¾	¼

1 Disch. Gage Connection
2 Suct. Gage Connection
3 Casing Drain
4 Seal Cage Connection
5 Vent Connection
6 Casing Connectors

Shaft deflection and bearing life as a result of radial and thrust loading.

SIZE		MAX. ROTATIVE SPEED RPM	RADIAL LOAD AT SHUTOFF (DESIGN (RPM) - LBS.	SHAFT DEFLECTION AT SHUTOFF		ESTIMATED BEARING LIFE HRS. (3) AT SHUTOFF LINE AND THRUST (10^3 HRS.)	SHAFT DIA. AT COUPLING IN.
				AT STUFFING BOX FACE	AT IMPELLER RING AREA		
(1) 1½ LLR7	A	3600	50	.0001	.0001	>300	.983
	C	3600	50	.0001	.0001	>300	.983
(1) 1½ LLR 10	A	3600	50	.0001	.0001	>300	.983
(1) 2 LLR 9	B	3600	50	.0001	.0001	>300	.983
	C	3600	50	.0001	.0001	>300	.983
2½ LR 10	C	3600	198	.0016	.0030	>300	.983
	D	3600	176	.0014	.0026	>300	.983
2½ LR 13	A	1800	233	.0010	.0019	>300	1.125
3 LR 9	A	3600	170	.0019	.0045	>300	.983
	C	3600	177	.0019	.0047	>300	.983
3 LR 12	A	1800	150	.0016	.0039	>300	.983
	K	1800	139	.0015	.0036	>300	.983
4 LR 10	A	1800	139	.0015	.0036	>300	.983
	B	3600	171	.0019	.0045	>300	.983
	G	3600	176	.0019	.0046	>300	.983
(2) 4 LR 11	A	3600	196	.0020	.0036	>300	1.125
	B	3600	147	.0016	.0027	>300	1.125
4 LR 12	B	1800	183	.0014	.0034	>300	.983
	E	1800	195	.0015	.0037	>300	.983
4 LR 14	B*	1800	260	.0020	.0033	>300	1.125
	D	1800	185	.0020	.0034	>300	1.125
5 LR 10	A	1800	187	.0015	.0035	>300	.983
	B	1800	204	.0016	.0038	>300	.983
5 LR 13	A	1800	182	.0020	.0033	>300	1.125
5 LR 15	D*	1800	500	.0019	.0026	>300	1.500
6 LR 10	B*	1800	348	.0019	.0048	>300	.983
	D	1800	263	.0020	.0048	>300	.983
6 LR 13	A*	1800	555	.0019	.0025	>300	1.500
6 LR 16	B*	1800	640	.0020	.0027	>300	1.500
(2) 6 LR 18	A	2000	387	.0010	.0026	>300	2.125
	B	2000	251	.0006	.0017	>300	2.125
(2) 8 LR 13	A	1800	283	.0015	.0020	>300	1.500
	B	1800	177	.0009	.0012	>300	1.500
(2) 8 LR 20	A	1900	514	.0013	.0034	>300	2.125
(2) 10 LR 15	A	2100	393	.0010	.0026	>300	2.125
	B	2100	390	.0010	.0026	>300	2.125
(2) 10 LR 18	A	1900	660	.0018	.0048	>300	2.500
12 LR 25		1200	230	.0018	.0053	>300	2.125
12 LR 17		1200	490	.0016	.0045	>300	3.250
16 LR 18		1200	340	.0018	.0055	>300	2.500
16 LR 20		1200	550	.0017	.0055	>300	3.250

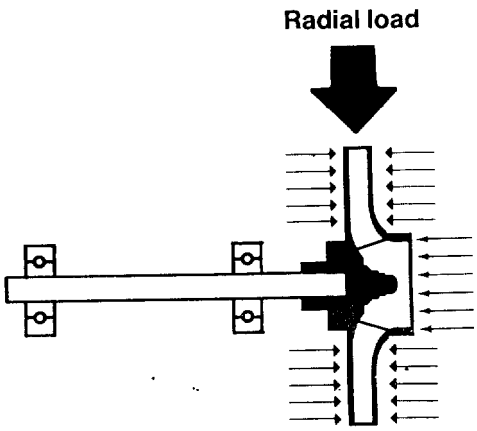
1. Opposed cutwaters 2. Twin volute casing

*Deflection at 50% BEP Capacity

3. For 3 LR 9 and larger pumps theoretically there is no thrust load due to hydraulic balance of impeller. Therefore bearing life of either bearing is directly related to the radial load.

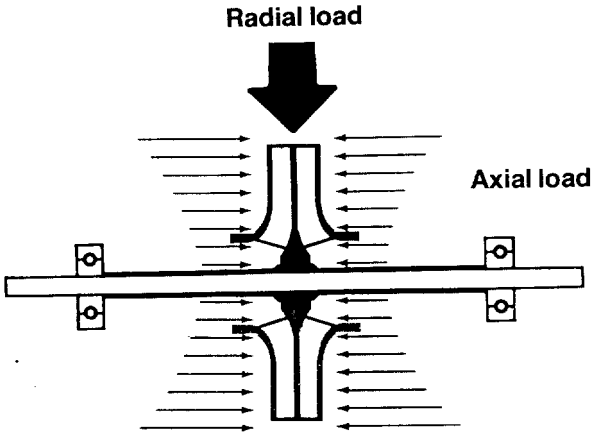
Why you can expect longer bearing life with Worthington horizontal, split-case pumps.

Figure 1



End suction pump

Figure 2



Horizontal split-case pump

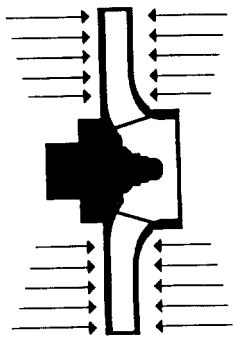
An end suction pump's impeller is cantilevered (overhung) from a bearing frame assembly, with the line bearing supporting the full radial load (Figure 1). The horizontal split case design (Figure 2) allows the impeller to be mounted in the center of the shaft, with supporting bearings on each end, each supporting one-half the radial load. Inherent in the split case design is the ability to use a smaller, shaft diameter since there is a dual-bearing support advantage. This also allows for lower shaft peripheral speed in the stuffing box area, resulting in longer packing and mechanical seal life — while maintaining shaft deflections of .002 inches or less at the stuffing box faces.

Axial load

In the case of end-suction impeller designs (Figures 3 and 4) an axial thrust load always exists — to a larger degree with open impellers, and a lesser degree with closed impellers. By its inherent design the horizontal split-case pump, hydraulically balances axial loads on the suction and discharge side of the impeller to practically eliminate axial thrust and provide longer bearing life than a similar end-suction pump sized for the same conditions of service.

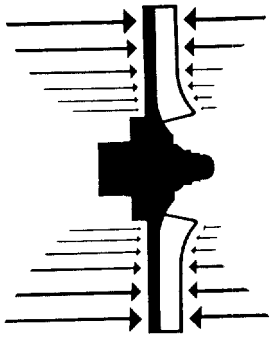
Combine the efficiency and reliability aspects of closed impellers and the lower NPSH requirements of double-suction impellers, with the inherent design advantages of Worthington horizontal split-case pumps, and chances are you'll join the thousands of pump users who are specifying Worthington horizontal split-case models.

Figure 3



Closed Impeller

Figure 4



Open Impeller

Materials of construction.

PART	STANDARD FITTED PUMP	IRON FITTED PUMP	ALL BRONZE PUMP	316 SS FITTED PUMP
Casing (1)	Cast Iron	Cast Iron	Bronze	Cast Iron
Casing Wear Ring	Bronze	Steel	Bronze	Steel
Casing Gasket	Vegetable Fiber	Vegetable Fiber	Vegetable Fiber	Vegetable Fiber
Casing Cap Screws	Steel	Steel	Monel	Steel
Impeller	Bronze	Cast Iron	Bronze	316 SS
Impeller Key	Steel	Steel	Monel	316 SS
Shaft	Carbon Steel	Carbon Steel	Carbon Steel	Carbon Steel
Shaft Sleeve	Bronze	316 SS	Bronze	316 SS
Shaft Sleeve O Ring	Buna - N	Buna - N	Buna - N	Buna - N
Shaft Sleeve Lock nut	Bronze	Steel	Bronze	Stainless Steel
Packing Gland	Cast Iron	Cast Iron	Bronze	Cast Iron
Studs & Nuts	Steel	Steel	Monel	Steel
Stuffing Box Bushing	Bronze	Steel	Bronze	Steel
Seal Cage	Teflon	Teflon	Teflon	Teflon
Bearing Bracket	Cast Iron	Cast Iron	Cast Iron	Cast Iron
Bearing Cover	Cast Iron	Cast Iron	Cast Iron	Cast Iron
Shaft Slinger	Neoprene	Neoprene	Neoprene	Neoprene
Packing	Graph Asb	Graph Asb	Graph Asb	Graph Asb
Mechanical Seal	BP-271	BP171	BP2C1	BP1C1
Spacer Sleeve	Bronze	Steel	Bronze	316 SS
Interstage Bushing	Bronze	Steel	Bronze	316 SS
Optional Construction				
Impeller	316 SS	316 SS	Monel	316 SS
Impeller Wear Ring	Bronze	Steel	Monel/bronze	316 SS
Shaft	316, 11-13 Chr.	316, 11-13 Chr.	Monel	316, 11-13 Chr.
Shaft Sleeves	(3)	(3)	(3)	(3)
Bearing Bracket			Bronze	
Packing (2)	Asbestos Lead Foil; Semimetallic Lead Foil — As Suitable for Application.			
Mechanical Seal (2)	Various J. Crane Types as Required For Application			

1 8 LR 20, 10 LR 18 & 12 LR 25 ductile iron casing standard
2 As Required
3 420 coated 316 SS; colomony coated 316 SS

MATERIAL	WORTHINGTON M DESIGNATION CASTING	ASTM DESIGNATION CASTING	WORTHINGTON M DESIGNATION WROUGHT	ASTM DESIGNATION WROUGHT
Cast Iron (1)	M-3112	A-278 Class 25 (A-B-C-S)	—	—
Ductile Iron	M-3128	A-395	—	—
Carbon Steel	M-3213	A-216 Grade WCB	—	—
316 S.S.	M-3265	A-296 Grade CF-8M	M-4270	A-276 Type 316
416 S.S.	—	—	M-4265	A-582 Grade 416
304 S.S.	—	—	M-4266 M	A-276 Type 304
Monel	M-3460	QQ-N-288	M-4460	B164 49T
SAE 1035	—	—	M-4215	A-576 Grade 1040
SAE 4140	—	—	M-4258-B	A-322 Grade 41L40
Bronze				
1. Marine	M-3445	B505 - All bronze construction	(1) for 250 lb Flanged pumps M3116	
2. Aluminum bronze	M-3455	Alloy 953 - STD FTD LLR	ASTM A278 Class 50	
3. Standard	M-3431B	B 145# 4A - STD FTD LR		

Typical specifications

1. Casing

The casing shall be of the volute type and designed to produce a smooth flow with gradual changes in velocity. The casing shall be split on the horizontal center line with the suction and discharge nozzles and casing feet cast integral with the lower casing half. The interior of the pump shall be easily inspected by removing the upper half of the casing. This shall be done without disturbing the pipe connections or pump alignment. The flanges between the halves will be sealed by a pre-cut gasket. The upper and lower halves of the casing shall be accurately located by the use of straight dowel pins to eliminate mismatch between the upper and lower halves which would impair both hydraulic and mechanical performance. The casing shall be hydrotested to one and one half times the working pressure; suction and discharge flanges shall contain drilled and tapped gage connections. The casing shall be single volute type. (The 4LR-11, 8LR-13, 6LR-18, 8LR-20, 10LR-15, 10LR-18, 12LR-17, 16LR-18, 16LR-20, and 12LR-25 shall be twin-volute type.)

LLR — On two-stage pumps the casing tongues shall be spaced 180 degrees apart, balancing radial loads. The crossover shall be cast in the upper half of the casing, affording an inherently rigid design necessary for high pressure applications.

2. Impeller

The impeller shall be a double-suction enclosed type. It shall be hydraulically balanced by its inherent design. The impeller shall be firmly secured to the shaft by a key positioned by shaft sleeves and both locked in place by shaft sleeve locknuts external to the stuffing box.

LLR — Two single-suction impellers shall be placed back to back to eliminate axial thrust. They shall be firmly secured to the shaft by a key positioned by shaft sleeves and both locked in place by shaft sleeve locknuts external to the stuffing box.

3. Renewable Case Rings

Renewable case rings shall be locked in place and protected against rotation by Monel pins. **Impeller Rings** — Securely held impeller rings can be supplied as an option.

4. Stuffing Box Bushing

Pump casing shall have a renewable stuffing box throat bushing.

5. Shaft Sleeve

Renewable shaft sleeves shall be provided which extend through stuffing box. They shall be securely keyed and held in place with shaft nuts incorporating set screws for locking purposes. Shaft sleeves shall be provided and sealed with "O" rings at impeller end.

6. Shaft

The shaft shall be heat-treated steel, ground to accurated dimensions and polished to a smooth surface. The shaft shall have the same nominal diameter from one shaft sleeve locknut to the other to minimize fatigue failure due to stress concentration. The shaft sleeves shall protect the shaft at the stuffing boxes. The sleeves shall be secured in lateral position by external shaft nuts. The impeller keys shall extend into the hub of the shaft sleeves to prevent slippage between the shaft and the sleeves. Sealing to protect against leakage under the shaft sleeve shall be accomplished by the use of "O" Ring type seals, located at the keyed end between the sleeve and the shaft. Shaft shall be adequately sized and designed to minimize deflection. The maximum run-out of shaft at stuffing box face shall not exceed .002" at shut off.

7. Bearings

The bearings shall be single row, deep-groove type ball bearings. They shall be designed and sized for at least 300,000 hours calculated minimum L10 rated bearing life at shut off per ANSI B 3.15. Each bearing shall be capable of carrying both line and thrust type loads. The thrust bearings shall be securely held to the shaft by a bearing locknut and washer.

LLR — Angular contact thrust bearing placed back to back shall be furnished on one end.

8. Bearing Brackets

The bearing brackets shall be separate from the pump casing and accurately machined and doweled to the casing. Oil or grease lubrication shall be provided. Grease gun fittings shall be standard on grease-lubricated pumps and a constant-level oiler shall be standard on oil lubricated pumps. Conversion from grease to oil shall be easily accomplished by simply removing the grease fittings and installing a constant-level oiler and vent. Pump design shall allow bearing to be removed without disturbing upper casing for inspection and replacement of bearings, mechanical seals and shaft sleeves.

9. Packing-Mechanical Seals

As a standard, stuffing boxes shall be packed with the best quality graphited asbestos packing. Die-molded packing shall be supplied and insure both a perfect seal and an easy installation. Mechanical seals shall be easily interchangeable with packing.

10. Spacer Sleeve (LLR Only)

A securely keyed spacer sleeve shall be provided to accurately position the impellers. The inter-stage bushing shall be held securely by a Monel set screw. Both sleeve and bushing shall be easily replaced to restore original clearances.

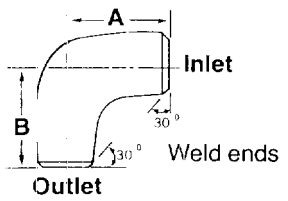
11. Casing Feet

The casing feet shall be integrally cast with the lower casing and be immediately adjacent to suction and discharge flanges in order to transmit any pipe strain loads to the base and foundation.

Unique patented suction elbow permits simpler piping which results in lower installed costs.

Worthington engineers have developed a unique suction-elbow with geometry that will provide relatively straight flow and uniform velocity at the exit. The Worthington design (Figure 2) uses a well-rounded orifice with the flow approaching from all sides. The area just preceding the outlet is larger than the outlet area. This increases the velocity as the fluid leaves the elbow. The combination of approaching the outlet from all sides, plus the acceleration, tends to straighten (or equalize) the flow on the elbow exit side. This design has been granted a U.S. Patent No. 3,910,715.

Friction loss data



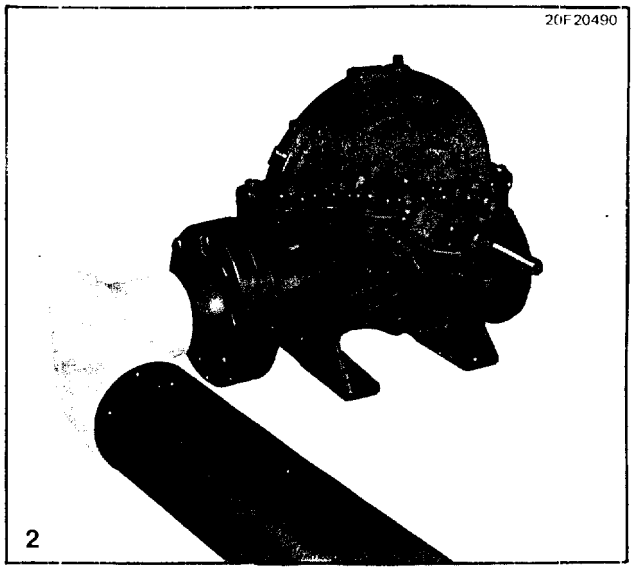
Head loss = $\frac{K v^2}{2g}$

V = outlet velocity $\frac{ft}{sec}$

Dimensions — Inches					Resistance
SIZE	Inlet	Outlet	A	B	Coefficient (K)
4x3	4	3	9	6	.25
6x4	6	4	9	9	.22
8x6	8	6	12	12	.18
10x8	10	8	15	15	.15
12x10	12	10	18	18	.14

1

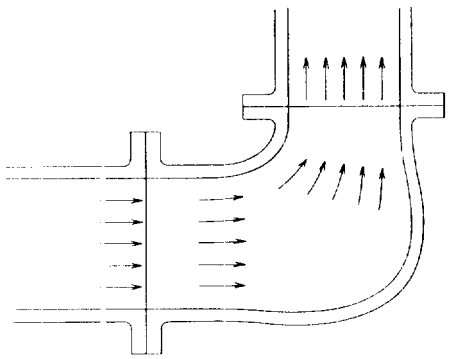
As fluid approaches an elbow, it is uniform in velocity. On the discharge side, velocity is irregular, requiring up to ten diameters of pipe to allow flow to equalize before entering the suction or leaving the discharge side of any pump.



2

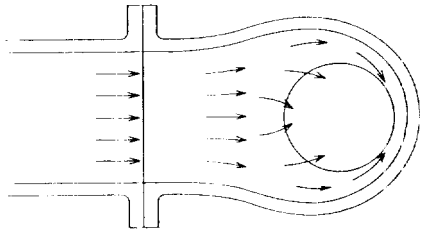
The Worthington-designed suction elbow allows for uniform velocity throughout a fluids passage through the elbow. The accelerated velocity at the outlet area, (Figure 3 and 4), eliminates the need for additional piping since flow does not require additional distance to equalize before entering the pump or after discharge.

velocity increases at outlet



3

velocity increases at outlet



4

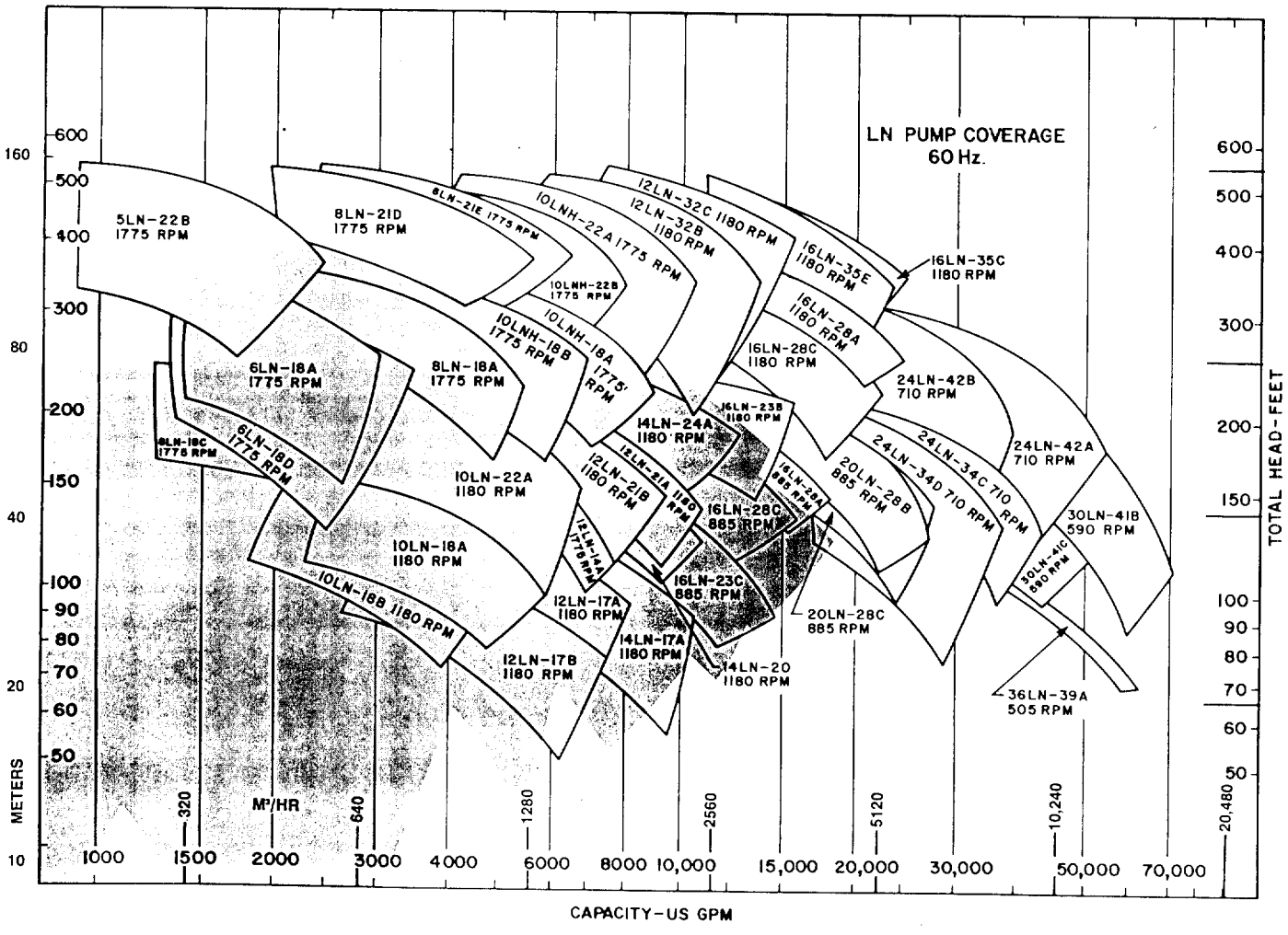
For broader coverage in higher capacity ranges, check Worthington LN pumps.

For applications outside the hydraulic scope of Worthington LR pumps, consider the proven efficiency and reliability of our LN product line.

The LN's versatile centrifugal double volute design minimizes radial thrust problems. It is essentially a low deflection machine: shaft and casing are all engineered to minimize deflection and consequent vibration, rubbing, and wear.

Compact, economical and easy to install with side or bottom suction and side discharge. The LN is adaptable to motor, engine or turbine drives. A variety of construction materials are available to meet your conditions of service.

Sizes 5-36 inches; capacities to 200,000 gpm; heads to 550 feet make the LN one of the most flexible pumps providing sustained efficiency and economy.



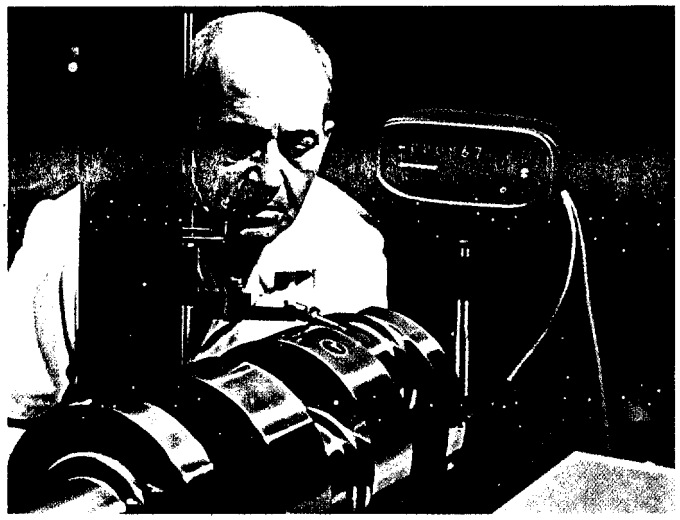
Nationwide distribution assures availability of pumps, parts and service.

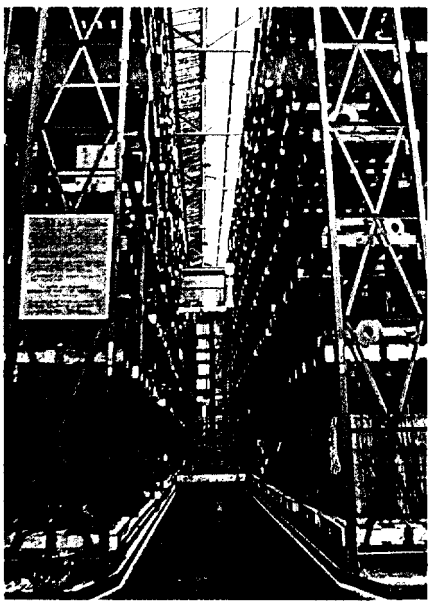
An extensive network of Worthington sales offices and franchised pump distributors, located in every major trading area, is your assurance that there is a Worthington representative near you for prompt, local service when you need it.

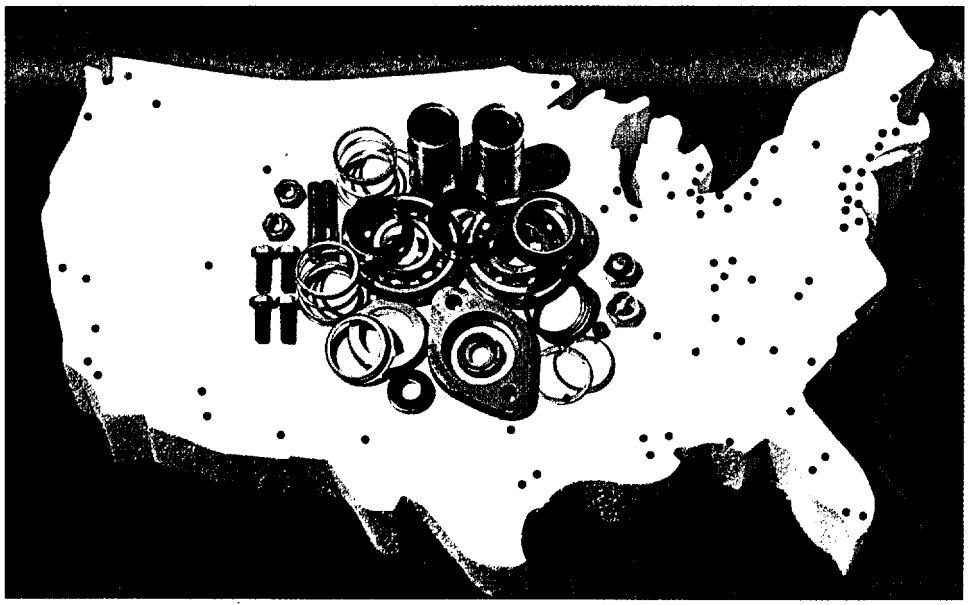
Worthington distributor representatives are factory trained specialists in pumping equipment. They can offer you expert assistance on pump application, selection, installation, operation, and maintenance.

Local availability is another benefit of selecting and using Worthington pumps. Worthington distributors carry large inventories of pumps and parts. In most cases, immediate shipment can be assured. And service is always nearby for prompt reaction to your specific needs.

You can locate the Worthington sales office or distributor in your area by consulting the Yellow Pages of your local telephone directory.







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2036-B1H